Volume 21 (2) **October 2014** **ISSN 0216-423X**

JABM
JOURNAL of ACCOUNTING - BUSINESS & MANAGEMENT

Journal of Accounting – Business & Management vol. 21 no. 2 (2014) 71-84

Macroeconomic Factors and Stock Market Returns: A Study in Indian Context

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Abstract

This paper analyses returns on four equity indices of the Indian capital market in the period from July 2000 to June 2010. Methodology involves sample adequacy tests, factor analysis followed by Cochrane and Orcutt regression analysis. Findings suggests that three statistical factors from linear combinations of several macroeconomic indicators explain significant cross sectional variation in return. These three factors may be proxy for money market factor, foreign involvement factor and domestic macroeconomic factor. The results suggest, consistent with other previous studies, that stock returns are a function of a number of previously identified set of macroeconomic variables. These macroeconomic variables could be represented by a number of estimated macro factors.

Keywords: stock returns, factor analysis, Cochrane Orcutt regression, global index.

I. INTRODUCTION

The Indian stock market is often termed as 'barometer' of Indian economy as movement and volatility of the stock markets generally reflect the change and direction of the economy. Therefore the relationship between stock market and macro economic factors is very important for policy makers and researchers. Asset pricing models available in the financial literature do not specify the fundamental macro economic factors that affect stock market. However modern financial theory suggests macro economic factors as sources of risk and contemplates that the long run return on an asset must reflect changes in such factors. Since the times of Merton in the early 1970s, asset pricing theorists visioned the need of factors, or sources of price risk beyond the performance of the market portfolio. The CAPM uses a time-series regression to measure beta, which quantifies a portfolio's tendency to move with the market as a whole. Multifactor models extend this theory. They use a time-series multiple regression to quantify an asset's tendency to move with multiple risk factors.

II. LITERATURE REVIEW

Impact of fundamental factors on market and stock prices are the most well-known factors over the long investment horizon. Evidence of this is provided e.g. by King (1966) who says that share prices and affected by macroeconomic factors up to 50% on average. The correlation between macroeconomic factors and share prices is a frequently discussed topic and has been covered by numerous studies, no matter if in the context of the emerging markets in eastern Asia (Mookerjee, Yu, 1997; Chung & Shin, 1999; Ibrahim & Aziz, 2003) or of developed markets such as the USA or Japan (Nelson, 1976; Jaffe &

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Mandelker, 1976; Fama & Schwert; 1977; Mukherjee, Naka, 1995; Bilson et al., 2000; Shiratsuka, 2003). Chatrath and Ramchander (1997) and Hu and Willett (2000) provide evidence from India that there are negative and significant relationship between inflation rate and real stock returns. In the Indian context, Naka et al. (1998) reported that domestic inflation is the most severe deterrent to Indian stock market performance, and domestic output growth is its predominant driving force.

Chancharat et al. (2007) found international stock markets from the region and oil prices influences stock returns in Thailand. Gregoriou et al. (2009) found a negative relationship between interest rate changes and British stock markets. Li et al. (2010) use the US's Federal fund rate and Canada's overnight rate, which are key policy rates, to study the effect of policy shock on stock prices. Buyuksalvarci (2010) study in Turkey reveal that the effect of gold prices is insignificant, whereas other macroeconomic variables are significant. Özlen and Ergun (2012) examined the relationship for Bosnia and Herzegovina stock market and macro variables using ARDL technique and evidenced that interest rate and exchange rate have significant factor in stock prices fluctuations and stock returns are sensitive to changes in factors. Sulaiman et al. (2012) suggested that domestic interests respond negatively to stock market, and inflation reported insignificantly to stock market in Pakisthan. Ahmad and Ghazi (2014) observed that Jordon stock index are influenced by credit to the private sector, weighted average interest rate on time deposits, and consumer price index.

For the Indian Economy, work in this area has not progressed much. Panda and Kamaiah (2001) investigated the causal relations and dynamic interactions among monetary policy, expected wholesale price index, real activity and stock returns in the post liberalization period, using a vector autoregression (VAR) approach. In another study, Mukhopadhyay and Sarkar (2003) conducted a systematic analysis of the Indian stock market returns and suggested that real economic activity, inflation, money supply growth, FDI, and the NASDAQ-index were significant in explaining variations in Indian stock return. Ray and Vani (2004) results revealed that, interest rate, industrial production, money supply, inflation rate and exchange rate have a significant influence on equity prices. Pal and Mittal (2011) results also showed that inflation and exchange rate have a significant impact on BSE Sensex but interest rate and gross domestic saving (GDS) were insignificant. Naik and Padhi (2012) evidenced long-term relationship between macroeconomic factors and stock return in Indian stock market.

III. DATA AND METHODOLOGY

3.1. Data

Data for the study have been obtained from different publications of RBI, Morgan Stanley Capital International publications (MSCI), US Energy Information Administration publications and NSE publications. The time period of study for this study is July 2000 to June 2010.

3.2. Methodology

Chen et al. (1986) suggested that selection of relevant macroeconomic variables requires judgment and for the present study, the explanatory variables are based upon existing theory and empirical evidences. The rationale for the selection of variables is based on intuitive financial theory (Chen et al., 1986; Mukherjee & Naka, 1995; McMillan, 2001; Srivastava, 2010). For the purpose, 13 variables were initially selected that are expected to affect stock returns and has been used in previous studies across the globe. The variables include:

1. Index of Industrial Production (IIP): index of industrial production in logarithmic form (LNIIP) for all commodities is included to represent the economic growth.
2. Broad Money Supply (M3): broad money supply in logarithmic form is included as a measure of money supply in the economy having a direct reflection of the monetary policy affecting financial development.
3. Call Money Rate (Call): the call rates may have an influence on stock market due to possible volatility linkages between capital and money markets, arising from two distinct sources–common information that affects expectations across markets and information spillover on account of cross-market hedging activities (Fleming et al., 1998).
4. Foreign Institutional Investors Inflow (FII): FII inflows are expected to have an impact on the stock market. It is often suggested that the FIIs enter in the stock market to reap the benefits and thereafter they withdraw their money and that increases the volatility in the underlying stock market. Alternatively, the introduction of the FIIs leads to more complete market, enhance information flow and thus improves the investment choices for investors, enhances the transparency in the market, put no impact on the volatility and due to low cost of investment, the return increases.
5. Foreign Exchange Reserve (FER): foreign exchange reserves acts as a defense against unexpected emergencies and economic shocks. The relationship of foreign reserves with stock market is important because international reserves accumulation has been the preferred policy recently adopted by developing economies to achieve financial stability. The aim of this policy is to increase liquidity and thus reduce the risk of suffering a speculative attack (Cruz & Walters, 2008).
6. Wholesale Price Index (WPI): wholesale price index in logarithmic form is included to represent the effect of inflation on Indian economy which may influence the stock prices. DeFina (1991) viewed that rising WPI may adversely affect the corporate income due to immediate rise of input costs but slow adjustment for output prices, resulting in lower profit which in turn affects the share prices.
7. Interest Rate on 10 years Government Bonds (INT): long term interest rates have the potential to affect share prices by affecting the discount rate used for valuation of equity. For the study, interest rates on 10 years government bonds have been considered to represent long term rates in Indian context.
8. Yield on Treasury Bill (TB): short term interest rates are expected to have some predictive power for stock returns. Ang and Bekaert (2007), and Campbell and Thompson (2008) find strong predictive power of the U.S. Treasury bill rate for U.S stock returns. The yield on Treasury Bills has been used in the study.
9. Growth Rate of Exchange Rate (GEX): Indian stock markets are expected to be affected by currency developments reflecting the impact of foreign income due to firm's exports measured in domestic currency. Growth of exchange rates has been used in the study and Indian rupee per unit of US $ is taken as proxy for exchange rate.
10. Price of Gold (GOLD): gold price in logarithmic form is included in the study as an additional variable, to examine whether gold price contain any additional significant information about stock price movements. Since gold is an important saving instrument in India and is very often used as a hedge against inflation, it is expected that gold may be looked upon as alternative asset used for portfolio diversification.
11. Price of Crude Oil (CRUDE): India is an oil importing country and price rise in crude oil virtually impacts industries and businesses across the board since increase in oil price directly adds to the operational costs, fuel costs, transportation costs, etc. This in turn may affects profitability since upward revision of output prices generally takes

time and typically occurs after rise in cost of fuel. The study uses spot price of Brent Crude oil in logarithmic form (LNCRUDE).

12. World Index (LNGLOBAL): in this era of globalization, the impact of global economy on the Indian stock market cannot be ruled out and changes in world stock markets may have some impact on an emerging stock market like India. MSCI World Index as maintained by Morgan Stanley Capital International is a free float-adjusted market capitalization weighted index that measures the equity market performance of developed markets and it is used as a proxy for global index. The MSCI World Index consists of the following 24 developed market country indices: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States. The logarithmic value of the global index has been used in the study.
13. Exports (LNX): movements of Indian stock market is very much linked to performances of technology providing companies and information technology companies. Most of these companies are exporter of services and contributes significantly to India's overall export. Additionally, Indian government provides various incentives to boost the export sector and performance of export sector which may indirectly affect stock market. The logarithmic value of the export has been used in the study.

A correlation analysis was done to find out if there exists any correlation between stock market returns and the selected range of variables. This was followed by regression analysis using the selected variables on four Indian stock market indices like NIFTY, SENSEX, CNX500 and BSE500. The following four regression equations are used:

1. $\boldsymbol{lnNIFTY_t} = \beta_0+\beta_1 LNIIP_t+\beta_2 LNM3_t+\beta_3 CALL_t+\beta_4 LNFII_t+\beta_5 LNX_t+\beta_6 LNFER_t$
$+\beta_7 LNWPI_t+\beta_8 INT_t+\beta_9 TB_t+\beta_{10} GEX_t+\beta_{11} LNGOLD_t+\beta_{12} LNGLOBAL_t$
$+\beta_{13} LNCRUDE_t+\varepsilon_t$ 1
2. $\boldsymbol{lnSENSEX_t} = \beta_0+\beta_1 LNIIP_t+\beta_2 LNM3_t+\beta_3 CALL_t+\beta_4 LNFII_t+\beta_5 LNX_t+\beta_6 LNFER_t$
$+\beta_7 LNWPI_t+\beta_8 INT_t+\beta_9 TB_t+\beta_{10} GEX_t+\beta_{11} LNGOLD_t+\beta_{12} LNGLOBAL_t$
$+\beta_{13} LNCRUDE_t+\varepsilon_t$ 2
3. $\boldsymbol{lnCNX500_t} = \beta_0+\beta_1 LNIIP_t+\beta_2 LNM3_t+\beta_3 CALL_t+\beta_4 LNFII_t+\beta_5 LNX_t+\beta_6 LNFER_t$
$+\beta_7 LNWPI_t+\beta_8 INT_t+\beta_9 TB_t+\beta_{10} GEX_t+\beta_{11} LNGOLD_t+\beta_{12} LNGLOBAL_t$
$+\beta_{13} LNCRUDE_t+\varepsilon_t$ 3
4. $\boldsymbol{lnBSE500_t} = \beta_0+\beta_1 LNIIP_t+\beta_2 LNM3_t+\beta_3 CALL_t+\beta_4 LNFII_t+\beta_5 LNX_t+\beta_6 LNFER_t$
$+\beta_7 LNWPI_t+\beta_8 INT_t+\beta_9 TB_t+\beta_{10} GEX_t+\beta_{11} LNGOLD_t+\beta_{12} LNGLOBAL_t$
$+\beta_{13} LNCRUDE_t+\varepsilon_t$ 4

Where:

- lnNIFTY, lnSENSEX, lnCNX500 and lnBSE500 are logarithmic form of NIFTY, SENSEX, CNX500 and BSE500 respectively.
- β_0; β_1; β_2; ..... β_{13} are the parameters to be estimated.
- ε_t is the error term.

Subsequently factor analysis is done to improve the results and shortlist which of the variables selected are most influential on the risk exposure of the stock market.

There are two approaches for identifying common sources of variations in stock returns–factor analysis of time series and cross-sectional analysis. The first method allows for isolation of independent sources of common variation in returns, while the latter

defines a set of security characteristics that can be tested to determine if they help explain differences in returns across securities (Kritzman, 1993).

Sources of common risk that contribute to changes in security prices are known as factors. If the factors can be identified, risk can be controlled more efficiently and returns can be improved. Factor analysis reveals covariation in returns and regression analysis affirms the sources of this covariation. The factor analysis is based on isolation of factors by observing common variations in the returns of different securities. The next step is to group or form portfolios of stock return, and observe if the returns of these groups can partly be explained by a common factor. Factors derived through factor analysis cannot always be interpreted, for example some factors cannot be assigned a measurable proxy or a factor may reflect a combination of several (perhaps offsetting) influences. So even if nearly all of a sample's variation in returns can be accounted for with independent factors, it can be difficult to assign meaning to these factors (Kritzman, 1993).

Two tests for sample adequacy like Kaiser-Meyer-Olkin measure (KMO) and Bartlett's test of sphericity is done to check the suitability of data for factor analysis.

Kaiser-Meyer-Olkin measure (KMO) (Kaiser, 1974): this statistic reflects the degree to which it is likely that common factors explain the observed correlations among the variables and is calculated as the sum of the squared simple correlations between pairs of variables divided by the sum of the squared simple correlations plus the sum of squared partial correlations. To the degree that partial correlations approach zero as common factors account for increasing variance among the variables, the KMO statistic will be higher when a common factor model is appropriate for the data. Small values for the KMO statistic indicate the correlations between pairs of variables cannot be accounted for by common factors. KMO therefore compares the magnitude of the calculated correlation coefficients to the magnitudes of partial coefficients and its value ranges from 0 to 1. Kaiser (1974) described KMO measure in the 0.90's as "marvelous", in the 0.80's as "meritorious", in the 0.70's as "middling", in the 0.60's as "mediocre", in the 0.50's as "miserable", and below 0.50 as "unacceptable". If the value of the statistic is below .50, the appropriateness of a factor model is seriously reconsidered, given the observed correlations. According to Kaiser (1974), a higher value (greater than 0.5) indicates that the degree of common variance among the variables are quite high and therefore factor analysis is appropriate.

Bartlett's test of sphericity (1950) assesses whether the correlation matrix of the variables to be factor analysed is actually an identity matrix. In other words, Bartlett's test of sphericity is a test of homogeneity of variances that hypothesizes that variables are uncorrelated in the population. The test statistic is distributed as chi-square distribution. When the value of the test statistic is sufficiently high, the probability level reaches statistical significance and the null hypothesis that the correlation matrix is an identity matrix can be rejected. Factor analysis is appropriate only on rejection of the hypothesis by the Barlett's test.

The factor analysis is used in the study for data reduction using SPSS 20 statistical package to develop an idea about the latent factors based on eigen values. With the factor scores, regression analysis is done on stock market data. To make it more general, we considered four Indian stock market indices–NIFTY, SENSEX, CNX500 and BSE500 in their logarithmic form. The following regression equations are used:

$$\boldsymbol{lnINDEX_{it}} = \delta_0+\delta_1 X'_t+\delta_2 X''_t+\delta_3 X'''_t+\varepsilon_t \quad \text{..... 5}$$

Where:

- $INDEX_i$ represents NIFTY, SENSEX, S&P CNX500 and BSE500 respectively.

- lnNIFTY, lnSENSEX, lnCNX500 and lnBSE500 are logarithmic form of NIFTY, SENSEX, CNX500 and BSE500 respectively.
- X', X'' and X''' are the factor scores used as independent variables.
- δ_0, δ_1, δ_2 and δ_3 are the parameters to be estimated.
- ε_t is the error term.

3.3. Data Analysis and Findings

3.3.1. Descriptive Statistics

Descriptive Statistics of macroeconomic variables are displayed in table 1.

Table 1
Descriptive Statistics of The Macroeconomic Factors

Variables	Mean	Median	Max.	Min.	S.D.	C.V.	Skewness	Kurtosis
LNIIP	5.39	5.38	5.86	5.05	0.22	0.04	0.12	1.76
LNM3	14.74	14.68	15.55	13.98	0.47	0.03	0.19	1.81
CALL	5.96	5.74	14.07	0.73	2.06	0.35	0.88	4.97
LNFII	9.79	10.07	11.71	7.88	1.09	0.11	-0.31	1.69
LNX	10.48	10.48	11.43	9.59	0.53	0.05	0.00	1.63
LNFER	11.75	11.85	12.66	10.46	0.68	0.06	-0.37	1.87
LNWPI	5.27	5.27	5.56	5.03	0.15	0.03	0.18	1.84
INT	7.52	7.48	11.81	5.11	1.45	0.19	0.81	4.00
TB	6.03	5.78	10.29	3.23	1.61	0.27	0.37	2.60
GEX	0.003	0.00	0.07	-0.04	0.02	45.57	1.00	7.40
LNGOLD	8.94	8.76	9.84	8.36	0.43	0.05	0.46	1.92
LNGLOBAL	8.10	8.11	8.55	7.61	0.24	0.03	-0.02	2.18
LNCRUDE	3.83	3.90	4.89	2.93	0.50	0.13	0.06	1.90

The descriptive statistics shows that the average value of the variables ranges from 0.003 to 14.74 while the standard deviation ranges from 2.06 to 0.02. All the variables have positive kurtosis but skewness is positive for all except LNGLOBAL, LNFER and LNFII.

3.3.2. Correlation Analysis

Correlation between macroeconomic variables and the stock market indices are displayed in table 2.

Table 2
Correlation Between Stock Market and Macroeconomic Variables

Variables	Correlation coefficient			
	Nifty	Sensex	CNX 500	BSE 500
LNIIP	0.937	0.935	0.932	0.932
LNM3	0.912	0.909	0.905	0.908
CALL	-0.160	-0.152	-0.191	-0.210
LNFII	0.967	0.967	0.978	0.977
LNX	0.938	0.935	0.935	0.936
LNFER	0.920	0.918	0.930	0.937
LNWPI	0.921	0.918	0.916	0.917
INT	-0.066	-0.072	-0.014	-0.016
TB	-0.102	-0.095	-0.138	-0.162
GEX	-0.537	-0.539	-0.561	-0.561
LNGOLD	0.895	0.891	0.879	0.879
LNGLOBAL	0.824	0.830	0.824	0.817
LNCRUDE	0.934	0.935	0.940	0.937

Correlation analysis clearly indicates significant correlation between stock market returns and macro economic variables. The exchange rate and interest rates related variables have a negative correlation with the stock returns.

3.3.3. Regression Analysis

Table 3
Regression Estimates using Macroeconomic Variables

Independent Variables	LNNIFTY	LNSENSEX	LNCNX500	LNBSE500
CONSTANT	-7.516***	-7.555***	-7.083***	-8.536***
LNIIP	.478***	.470***	.612***	.447**
LNM3	.545***	.600***	.130	.314
CALL	-.008	-.007	-.007	-.003
LNFII	.152***	.157***	.198***	.164***
LNX	-.193***	-.195***	-.211**	-.174*
LNFER	-.164*	-.194**	-.094	-.088
LNWPI	-.824**	-.849**	-.094	-.360
INT	-.019	-.023*	-.026*	-.045***
TB	.013	.013	-.009	-.016
GEX	.010	-.060	-.103	-.724
LNGOLD	.433***	.446***	.375***	.370***
LNGLOBAL	.864***	.957***	.885***	1.072***
LNCRUDE	.176***	.194***	.258***	.271***
R-square	0.993	0.993	0.992	0.991
DW Statistic	1.220	1.269	1.228	1.249
F Statistic	1147.661**	1185.295***	964.552***	930.318***

Table 4
Collinearity Statistics of Macroeconomic Variables

Independent Variables	Variance Inflation Factors (VIF)
LNIIP	40.642
LNM3	267.898
CALL	5.099
LNFII	21.635
LNX	55.555
LNFER	166.551
LNWPI	107.766
INT	14.645
TB	10.509
GEX	1.306
LNGOLD	56.680
LNGLOBAL	10.844
LNCRUDE	25.911

Findings from regression analysis (table 3) shows that R-squared value in each of the four regression results are very high but low value of Durbin Watson statistic (DW) shows that autocorrelation may be present and that may be a cause for such high R-squared values. Additionally Variance Inflation Factors (VIF) test (table 4) for collinearity shows that variables used in the study may be collinear since most of the VIF values are above 5. Hence factor analysis is used to improve the findings.

3.3.4. Factor Analysis

Table 5
KMO and Bartlett's Test Results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.827
Bartlett's test of sphericity	Approx. Chi-Square	3160.739
	Df	78
	Significance level	.000

The findings for tests of sample adequacy are displayed in table 5. The KMO measure of 0.827 indicates that the degree of common variance among the variables is quite high and the null hypothesis of Bartlett's test of sphericity is rejected as shown by very small value of significance. These findings suggest that the data is appropriate for principal component analysis.

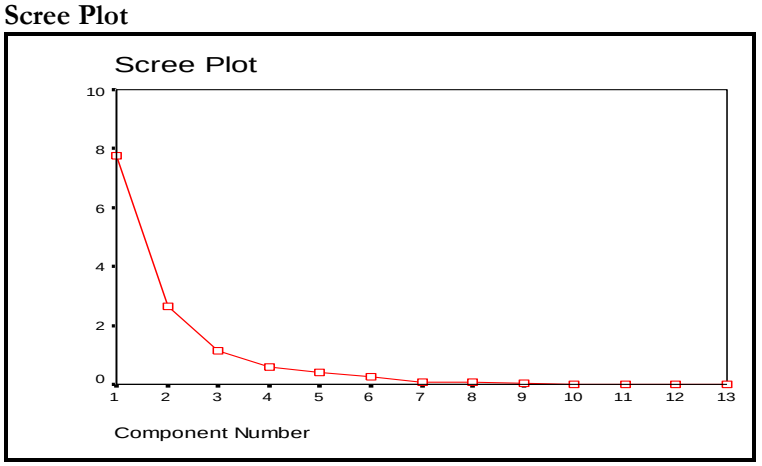
Table 6
Total Variance and Cumulative Variation

Com-ponent	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumu-lative %	Total	% of Variance	Cumu-lative %	Total	% of Variance	Cumu-lative %
1	7.75	59.632	59.632	7.75	59.632	59.632	7.46	57.390	57.390
2	2.64	20.323	79.955	2.64	20.323	79.955	2.64	20.345	77.735
3	1.15	8.893	88.848	1.15	8.893	88.848	1.44	11.114	88.848
4	.583	4.482	93.331						
5	.404	3.107	96.438						
6	.248	1.908	98.346						
7	.079	.610	98.956						
8	.066	.507	99.463						
9	.029	.223	99.686						
10	.017	.133	99.819						
11	.014	.109	99.928						
12	.007	.053	99.981						
13	.002	.019	100.000						

Extraction method: principal component analysis.

The table 6 reports the variations explained by each component as well as the cumulative variation explained by all components. Variance explained with regard to this table refers to the amount of variance in the total collection of variables/items which is explained by the component(s).

Figure 1
Scree Plot



A scree plot is useful in determining the appropriate number of components to interpret. It displays the eigen values on the vertical axis and the principal component number on the horizontal axis. Eigen values are produced by a process called principal components analysis (PCA) and the eigenvalue for a given factor measures the variance in all the variables which is accounted for by that factor. The ratio of eigen values is the ratio of explanatory importance of the factors with respect to the variables. If a factor has a low eigen value, then it is contributing little to the explanation of variances in the variables and may be ignored as redundant with more important factors. As one moves to the right in the scree plot, toward later components, the eigen values drop meaning decreasing order of contribution to total variance. In the above scree plot (Figure 1), from the fourth factor onwards the line is almost flat, meaning the each successive factor is accounting for smaller and smaller amounts of the total variance. Hence we consider only three components.

Table 7
Rotated Component Matrix (a)

Variables	Component		
	1	2	3
LNIIP	.973	-.136	-.019
LNM3	.966	-.204	.016
CALL	-.177	.874	.162
LNFII	.947	-.031	-.080
LNX	.986	-.101	.029
LNFER	.960	-.226	-.009
LNWPI	.975	-.164	.037
INT	-.055	.871	.073
TB	-.146	.942	.166
GEX	.036	.116	.843
LNGOLD	.951	-.158	.041
LNGLOBAL	.007	.184	.814
LNCRUDE	.938	.116	.024

Extraction method: principal component analysis.
Rotation method: varimax with Kaiser normalization.
a . Rotation Converged in 5 Iterations

The rotated component matrix (table 7) shows variable loadings on the components after rotation. IIP, M3, FII inflow, export, foreign exchange reserve, WPI, gold and crude prices load heavily on component 1. Call money rates, long term interest rates and treasury bill rates loads on component 2 while growth of global indices and exchange rates (Rupee vs US dollar) loads on component 3.

With the above results, factor scores are obtained. The score for a given factor is a linear combination of all of the measures, weighted by the corresponding factor loading. The first factor (F1) includes a combination of IIP, M3, FII inflow, export, foreign exchange reserve, WPI, gold and crude prices. The second factor (F2) includes money market related interest rates like call money rates, long term interest rates and Treasury bill rates. The third factor (F3) includes the global index and exchange rates (Rupee vs US dollar). With the factor scores, a regression analysis is conducted on stock market data. To make it more general, we use four Indian stock market indices–NIFTY, SENSEX, CNX 500 and BSE 500 in their logarithmic form (ln). The results are tabulated in table 8.

Table 8
Regression Results using Factor Scores

Dependent Variable	Independent Variables	Coefficient	t statistic	p value	F value	R^2	DW Statistic
lnNIFTY	F1	0.5836	48.01	0.0000	774.55	0.95	0.526
	F2	0.0332	2.73	0.0072	(0.00)		
	F3	-0.0403	-3.31	0.0012			
	Constant	7.7287	638.50	0.0000			
lnSENSEX	F1	0.6158	47.39	0.0000	756.04	0.95	0.528
	F2	0.0402	3.09	0.0025	(0.00)		
	F3	-0.0449	-3.45	0.0008			
	Constant	8.9063	688.42	0.0000			
lnCNX500	F1	0.6399	42.25	0.0000	599.21	0.94	0.42
	F2	0.0099	0.65	0.5145	(0.00)		
	F3	-0.0524	-3.46	0.0007			
	Constant	7.4905	496.65	0.0000			
lnBSE500	F1	0.6731	43.23	0.0000	631.26	0.94	0.435
	F2	-0.0057	-0.36	0.7147	(0.00)		
	F3	-0.0773	-4.96	0.0000			
	Constant	7.9283	511.32	0.0000			

The figures in parentheses are the respective p values.

The DW statistics suggested presence of serial correlation in residuals violating the basic assumptions of regression analysis. Hence Cochrane and Orcutt (1949) procedure is used that uses serial correlation coefficient differenced data and adjusts a linear model for serial correlation in the error term.

3.3.5. Cochrane and Orcutt Procedure

First from the model estimated above, the residuals ε_t are obtained. Then the residual is regressed on its lagged value as $\boldsymbol{\varepsilon_t} = \hat{e}\varepsilon_{t-1} + \mu_t$.

This gives us an OLS estimate of the autoregressive parameter ê. The variables in the model are transformed in such a way that the new model we are estimating takes the form:

$$\boldsymbol{Y_t - \hat{e}y_{t-1}} = (1-\hat{e})\beta_0 + 1 + \beta_1(X'_t - X'\hat{e}t\text{-}1) + \beta_2(X''_t - X''\hat{e}t\text{-}1) + \beta_3(X'''_t - X'''\hat{e}t\text{-}1) + \mu_t \quad \ldots\ldots 6$$

This model is estimated via OLS and we get the same estimates as before, but now the standard errors are valid.

The results of the regression after adjusting for serial correlation are tabulated in table 9 (insert table 9 here).

The regression results indicate that statistical factors play a significant role in explaining stock market returns. All the factors are significant for all indices. The first factor that includes a combination of IIP, M3, FII inflow, export, foreign exchange reserve, WPI, gold and crude prices has positive relation with stock market. The second factor is the money market related factor that includes Call money rates, long term interest rates and treasury bill rates and the third factor includes global index and exchange rates (Rupee vs US dollar).The money market related second factor coefficient is negative in all the four cases indicating inverse relationship between interest rates and stock returns. The global involvement factor consisting of changes in global indices and exchange rate also shows a negative relationship with stock market return. Exchange rate depreciation suggests higher inflation in the future, which makes investors skeptical about the future

performance of companies. As a result, the stock prices drop suggesting negative relationship.

Table 9
Cochrane and Orcutt Estimates–Regression after Adjusting for Serial Correlation

Dependent Variable	Independent Variables	Coefficient	t statistic	p value	F value	R^2	DW Statistic
	F1	0.3355	4.54	0.0000	7.35	0.988	1.54
lnNIFTY	F2	-0.0716	-3.20	0.0017	(0.00)		
	F3	-0.0115	-1.93	0.0559			
	Constant	7.8199	23.74	0.0000			
lnSENSEX	F1	0.3089	4.04	0.0001	5.91	0.989	1.52
	F2	-0.0660	-2.90	0.0044	(0.00)		
	F3	-0.0110	-1.83	0.0697			
	Constant	9.1266	17.90	0.0000			
lnCNX500	F1	0.3290	3.95	0.0001	5.58	0.988	1.51
	F2	-0.0730	-2.95	0.0038	(0.00)		
	F3	-0.0101	-1.58	0.1157			
	Constant	7.6860	16.83	0.0000			
lnBSE500	F1	0.2556	2.70	0.0079	7.64	0.986	1.85
	F2	-0.0388	-1.37	0.1716	(0.00)		
	F3	-0.0300	-4.00	0.0001			
	Constant	8.5116	13.47	0.0000			

The figures in parentheses are the respective p values.

IV. CONCLUSION

The three statistical factors formed using factor analysis from linear combinations of several macroeconomic indicators seems to explain significant cross sectional variation in return. These three factors may be proxy for domestic macroeconomic factor, money market factor and foreign involvement factor. The relationship between domestic macroeconomic factors and stock market is well documented in literature (Black et al., 1997). The money market related second factor coefficient is negative in all the four cases indicating inverse relationship between interest rates and stock returns. This is as per expectation since higher interest rate reduces value of equity as predetermined by dividend discount model, makes fixed income securities more attractive as an alternative to holding stocks, may reduce the tendency of investors to borrow and invest in stocks and raise the cost of doing business affecting profit resulting in investors demanding higher premium. The foreign involvement factor also shows inverse relationship with stock return. A growing stock market attracts capital flows from abroad and foreign exchange flows lowers the exchange rate (Rs per US dollar). Also negative return in global markets attracts foreign investors to the growing market and this again creates capital flows and subsequent lowering of exchange rate (Rs per US dollar). This findings are in agreement with findings of earlier studies that macroeconomic factors like interest rates negatively influences stock return (Buyuksalvarci, 2010; Sulaiman et al., 2012; Ahmad & Ghazi, 2014), oil prices and stock markets are inversely related (Chancharat et al., 2007) and other factors like inflation, money supply, other foreign stock market performances and exchange rates influences stock market (Mukhopadhyay & Sarkar, 2003; Chancharat et al., 2007; Özlen & Ergun, 2012; Naik & Padhi, 2012). Nevertheless, contrary to the findings of Buyuksalvarci (2010), gold prices were seen to have serious influence on stock return. This is not surprising in the sense that gold have huge social value in India and is used as a hedging instrument in India at the time of crises. The findings also contradicts findings of Pal and Mittal (2011) where insignificant relationship between interest rates and stock

return has been established in India. However, present study attempts to capture the dynamic influences of various macroeconomic factors on stock return from a different dimension using statistical factors that act as a latent variable. The results presented here suggest, consistent with other previous studies, that stock returns are a function of a number of previously identified set of macroeconomic variables. These macroeconomic variables could be represented by a number of estimated macro factors. The implication of the findings would be for both the government as well as for multinationals. It may affect decisions about monetary and fiscal policy. A booming stock market has a positive effect on aggregate demand (Gavin, 1989). If this is large enough, expansionary monetary or contractionary fiscal policies that target the interest rate and the real exchange rate will be neutralized. There is some tendency of some policy-makers to advocate less expensive currency in order to boost the export sector. They should be aware whether such a policy might depress the stock market. Additionally, the linkage between the two markets may be used to predict the path of the exchange rate. This will benefit multinational corporations in managing their exposure to foreign contracts and exchange rate risk and thus stabilizing their earnings. Multinational companies interested in exchange rate forecasting may consider the stock market as a forecasting indicator—when it rises, the currency is expected to depreciate.

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